CLAIMS.

We claim:

1. A method for measuring the location of objects arranged on a surface in space, comprising: a plurality of cameras arranged in a stationary array about the objects, each capable of forming an image of the scene containing the objects; a means for marking the locations of the objects in the images, using a two-dimensional coordinate system; a method for fitting a parameterized mathematical surface in three-dimensional space, congruent with the surface containing the observed object coordinates; a method to establish the correct object mappings; that is, which sets of coordinate pairs represent the same object as viewed in various cameras; and a method to triangulate the exact three-dimensional coordinates of the objects.

2. The method of claim (1) in which the cameras are video cameras connected to a data storage and processing means.

3. The method of claim (1) in which the means for marking the locations of objects in the images is a graphical user interface (GUI) providing the user with a means to visually inspect the images and manually select the coordinates of the objects.

4. The method of claim (1) in which the means for marking the locations of objects in the images, is based on a pattern recognition method such as is well known in the art of image understanding.

5. The method of claim (1) in which the parameterized surface is represented as a regular ellipsoid whose parameters are the center coordinates, axis orientations and major axis lengths.

6. The method of claim (1) in which the parameterized surface is represented as a triangulated spheroidal shape, where the radius of each vertex may be individually and independently represented by a single parameter, or where the radii of some vertices may be interpolated from neighboring parameterized vertices.

7. The method of claim (1) in which the method of optimization of the parameterized surface is Powell's method, and the functional is a squared distance function. This squared distance function is defined with respect to a set of rays, each drawn starting from the location of a camera in three-dimensional space, and through each observed object location in the unit image plane as viewed from that camera. Each of these rays forms an intersecting point with the parameterized surface, and the squared error function is defined as the sum of the distance between each of these intersections, and its closest neighboring intersections.

8. The method of claim (7), except that after the set of intersecting points on the parameterized surface is computed, then those points are clustered into N clusters, where N is the true number of objects in the scene. Clustering may be accomplished using a K-means algorithm, for example. For each cluster, its centroid is calculated, and the squared-error function is the sum of the distances from each centroid to each of the points comprising the cluster.

9. The method of claim (8) in which the correct mappings are established using a Markov Chain Monte Carlo (MCMC) method such as the Metropolis algorithm, so as to minimize the clustered squared-error function as defined in claim 8, where the clusters are established using the MCMC method.

10. The method of claim (1) in which the method for establishing the correct mappings is an iterative (greedy) algorithm, beginning with the objects which are observed closest to the center of each image. Each of these observations is mapped to those observations in other cameras whose intersections with the parameterized surface is closest.

11. The method of claim (1) in which the objects are electrophysiological sensors arranged on the head of a subject, and the method is used to establish the coordinates of the sensors.

12. The method of claim (1) in which the sensor locations are analyzed using a Delaunay triangulation, and this Delaunay triangulation is compared with a similar triangulation

derived from engineering drawings of the sensor net, in order to establish the identifications of each individual sensor within the net.

13. An apparatus for measuring the location of objects arranged on a surface in space, comprising: a plurality of cameras arranged in a stationary array about the objects, each capable of forming an image of the scene containing the objects; and a data processing apparatus which implements a method to find the coordinates of the objects in the images, to fit a parameterized mathematical surface congruent with the locations of the objects, to establish the correct mappings between observations of the various objects, and to triangulate the exact three-dimensional coordinates of the objects.

14. The apparatus of claim (13) in which up to twelve cameras may be located at the vertices of a regular icosahedral gantry structure surrounding the objects.

15. The apparatus of claim (14) where the objects are electrophysiological sensors arranged on the head of a subject, and one of the cameras is omitted from the icosahedral gantry structure so as to make room for the subject's body. The apparatus is used to establish the coordinates of the sensors.

16. The apparatus of claim (15) in which the icosahedral camera gantry is mounted on a swinging pivot, so that it may be lifted out of the way while the subject enters or exits the apparatus.